

I/WE CLAIM:

1. A method of throttling event messages to be forwarded from an element management system (EMS) to a network management system (NMS), the EMS including a Qs channel process for communicating with the NMS, the method comprising the steps of:

maintaining a set of at least one proxy buffer at the Qs channel process, the set having a fill level;

receiving an event message associated with a network element;

at a point separate from the Qs channel process, determining from at least the fill level whether the event message is to be forwarded; and

if the event message is to be forwarded, forwarding the event message to the Qs channel process for storage in the at least one proxy buffer.

2. The method of claim 1 wherein the event message has a priority which is either low or high, wherein the set of at least one proxy buffer has a state, the state being variable, being reflective of the fill level, and being at any point in time one of Low, High, or Full, and wherein determining whether the event message is to be forwarded comprises:

if the state is Low, determining that the event message is to be forwarded;

if the state is High and the event message has a high priority, determining that the event message is to be forwarded;

if the state is High and the event message has a low priority, determining that the event message is not to be forwarded; and

if the state is Full, determining that the event message is not to be forwarded.

3. The method of claim 2 comprising the further steps of:

if the event message is not to be forwarded and the event message has a high priority, placing the network element out of sync; and

if the event message has a low priority:

storing the event message in a local buffer associated with the network element;

determining whether the local buffer has overflowed; and

if the local buffer has overflowed, placing the network element out of sync.

4. The method of claim 2 comprising the further steps of:

if the fill level of the set rises to or above a first threshold T_{LH} , setting the state to High;

if the fill level of the set rises to or above a second threshold T_{HF} , setting the state to Full;

if the fill level of the set falls to or below a third threshold T_{FH} , setting the state to High; and

if the fill level of the set falls to or below a fourth threshold T_{HL} , setting the state to Low;

wherein the thresholds have values satisfying the relationship

$$T_{HL} \leq T_{LH} < T_{FH} \leq T_{HF}.$$

5. The method of claim 4 wherein the thresholds have values satisfying the relationship

$$T_{HL} < T_{LH} < T_{FH} < T_{HF},$$

thereby providing a hysteresis effect.

6. An element management system (EMS) for forwarding event messages to a network management system (NMS), comprising:

a Qs channel process for communicating with the NMS;

a set of at least one proxy buffer maintained by the Qs channel process, the set having a fill level;

an event logger for receiving an event message associated with a network element, for determining from at least the fill level whether the event message is to be forwarded, and for forwarding the event message to the Qs channel process for storage in the at least one proxy buffer in the event that the event message is to be forwarded.

7. The EMS of claim 6 wherein the event logger is adapted to maintain a state of the at least one proxy buffer, the state being variable, being reflective of the fill level, and being at any point in time one of Low, High, or Full, wherein the event message has a priority which is either high or low, and wherein the event logger comprises:

instructions for determining that the event message is to be forwarded, in the event that the state is Low;

instructions for determining that the event message is to be forwarded, in the event that the state is High and the event message has a high priority;

instructions for determining that the event message is not to be forwarded, in the event that the state is High and the event message has a low priority; and

instructions for determining that the event message is not to be forwarded, in the event that the state is Full.

8. The EMS of claim 7 wherein the Qs channel process comprises:

instructions for determining whether the fill level crosses one of four configurable thresholds; and

instructions for sending a callback message to the event logger indicative of which threshold was crossed by the fill level, in the event that the fill level crosses one of the thresholds.

9. The EMS of claim 8 wherein the event logger further comprises:

instructions for setting the state to High, in the event that the callback message is indicative of the fill level rising to or above the first threshold T_{LH} ;

instructions for setting the state to Full, in the event that the callback message is indicative of the fill level rising to or above the second threshold T_{HF} ;

instructions for setting the state to High, in the event that the callback message is indicative of the fill level falling to or below the third threshold T_{FH} ;
and

instructions for setting the state to Low, in the event that the callback message is indicative of the fill level falling to or below the fourth threshold T_{HL} ;

wherein the thresholds have values satisfying the relationship

$$T_{HL} \leq T_{LH} < T_{FH} \leq T_{HF} .$$

10. The EMS of claim 9 wherein the thresholds have values satisfying the relationship

$$T_{HL} < T_{LH} < T_{FH} < T_{HF} ,$$

thereby providing a hysteresis effect.

11. The EMS of claim 7 wherein the Qs channel process comprises:

instructions for determining whether the fill level crosses one of four configurable thresholds;

instructions for determining the state of the set, in the event that the fill level crosses one of the four configurable thresholds; and

instructions for sending a callback message to the event logger indicative of the state, in the event that the fill level crosses one of the thresholds.

12. The EMS of claim 11 wherein the instructions for determining the state of the set comprise:

instructions for setting the state to High, in the event that the fill level rises to or above the first threshold T_{LH} ;

instructions for setting the state to Full, in the event that the fill level rises to or above the second threshold T_{HF} ;

instructions for setting the state to High, in the event that the fill level falls to or below the third threshold T_{FH} ; and

instructions for setting the state to Low, in the event that the fill level falls to or below the fourth threshold T_{HL} ;

wherein the thresholds have values satisfying the relationship

$$T_{HL} \leq T_{LH} < T_{FH} \leq T_{HF}.$$

13. The EMS of claim 12 wherein the thresholds have values satisfying the relationship

$$T_{HL} < T_{LH} < T_{FH} < T_{HF},$$

thereby providing a hysteresis effect.

14. A method of monitoring a fill level of a set of at least one proxy buffer at a Qs channel process responsible for forwarding event messages from an element management system (EMS) to a network management system (NMS), comprising the steps of:

configuring a first threshold T_{LH} , a second threshold T_{HF} , a third threshold T_{FH} and a fourth threshold T_{HL} , the thresholds having values satisfying the relationship

$$T_{HL} \leq T_{LH} < T_{FH} \leq T_{HF};$$

upon receipt of an event message from the EMS:

forwarding the event message to the NMS;

adding the event message to the set; and

determining whether addition of the event message to the set caused the fill level of the set to rise to or above either the first threshold or the second threshold;

upon receipt of an acknowledgment message from the EMS:

deleting an event message corresponding to the acknowledgment from the set; and

determining whether deletion of the event message from the set caused the fill level of the set to fall to or below either the third threshold or the fourth threshold; and

if addition of the event message to the set caused the fill level of the set to rise to or above either the first threshold or the second threshold, or if deletion of the event message from the set caused the fill level of the set to fall to or below either the third threshold or the fourth threshold, sending a callback message to an event logger in the EMS indicative of which threshold has been crossed by the fill level.

15. The method of claim 14 wherein the step of sending a callback message to the event logger indicates which threshold was crossed by the fill level.

16. The method of claim 14 further comprising the steps of:

defining a state of the set of at least one proxy buffer, the state being variable and being at any point in time one of Low, High, or Full;

if the fill level rises to or above the first threshold, setting the state to High;

if the fill level rises to or above the second threshold, setting the state to Full;

if the fill level falls to or below the third threshold, setting the state to High;

if the fill level falls to or below the fourth threshold, setting the state to Low;

and wherein the step of sending a callback message to the event logger indicates the state of the set.

17. The method of claim 16 wherein the thresholds have values satisfying the relationship

$$T_{HL} < T_{LH} < T_{FH} < T_{HF} ,$$

thereby providing a hysteresis effect.

18. A computer-readable medium storing software for monitoring a fill level of a set of at least one proxy buffer at a Qs channel process responsible for forwarding event messages from an element management system (EMS) to a network management system (NMS), the computer-readable medium comprising:

instructions for configuring a first threshold T_{LH} , a second threshold T_{HF} , a third threshold T_{FH} and a fourth threshold T_{HL} , the thresholds having values satisfying the relationship

$$T_{HL} \leq T_{LH} < T_{FH} \leq T_{HF} ;$$

instructions for forwarding an event message to the NMS upon receipt of the event message from the EMS;

instructions for adding the event message to the set upon receipt of the event message from the EMS;

instructions for determining whether addition of the event message to the set caused the fill level of the set to rise to or above either the first threshold or the second threshold, upon addition of an event message to the set;

instructions for deleting an event message corresponding to an acknowledgment from the set, upon receipt of an acknowledgment message from the EMS;

instructions for determining whether deletion of the event message from the set caused the fill level of the set to fall to or below either the third threshold or the fourth threshold, upon deletion of an event message from the set;

instructions for sending a callback message to an event logger in the EMS indicative of which threshold has been crossed by the fill level, in the event that addition of the event message to the set caused the fill level of the set to rise to or above either the first threshold or the second threshold, or that deletion of the event message from the set caused the fill level of the set to fall to or below either the third threshold or the fourth threshold.

19. A method of throttling event messages at an element management system (EMS), the EMS including a Qs channel process for communicating with a network management system (NMS) and for maintaining a set of a plurality of proxy buffers collectively having a fill level, the method comprising the steps of:

intermittently receiving from the Qs channel process a callback message indicative of the fill level;

receiving an event message associated with a network element;

determining from at least the fill level whether the event message is to be forwarded; and

if the event message is to be forwarded, forwarding the event message to the Qs channel process for storage in the set of at least one proxy buffer.

20. The method of claim 19 further comprising the step of storing a state of the set, the state being variable, reflective of the fill level, and being at any point in time one of Low, High, and Full, wherein the callback message is indicative of the state, wherein the event message has a priority which is either high or low, and wherein the step of determining whether the event message is to be forwarded comprises the steps of:

if the state is Low, determining that the event message is to be forwarded;

if the state is High and the event message has a high priority, determining that the event message is to be forwarded;

if the state is High and the event message has a low priority, determining that the event message is not to be forwarded; and

if the state is Full, determining that the event message is not to be forwarded.

21. The method of claim 20 comprising the further steps of:

if the event message is not to be forwarded and the event message has a high priority, placing the network element out of sync; and

if the event message has a low priority:

storing the event message in a local buffer associated with the network element;

determining whether the local buffer has overflowed; and

if the local buffer has overflowed, placing the network element out of sync.

22. The method of claim 20 wherein the callback message indicates which one of four configured thresholds has been crossed by the fill level, and comprising the further steps of:

if the fill level has risen to or above the first threshold T_{LH} , setting the state to High;

if the fill level has risen to or above the second threshold T_{HF} , setting the state to Full;

if the fill level falls to or below the third threshold T_{FH} , setting the state to High;

if the fill level falls to or below the fourth threshold T_{HL} , setting the state to Low;

and wherein the thresholds satisfy the relationship

$$T_{HL} \leq T_{LH} < T_{FH} \leq T_{HF}.$$

23. The method of claim 22 wherein the thresholds satisfy the relationship

$$T_{HL} < T_{LH} < T_{FH} < T_{HF},$$

thereby providing a hysteresis effect.

24. A computer-readable medium storing software for throttling event messages at an element management system (EMS), the EMS including a Qs channel process for communicating with a network management system (NMS) and for maintaining a set of a plurality of proxy buffers collectively having a fill level, the computer-readable medium comprising:

instructions for receiving from the Qs channel process a callback message indicative of the fill level;

instructions for receiving an event message associated with a network element;

instructions for determining from at least the fill level whether the event message is to be forwarded; and

instructions for forwarding the event message to the Qs channel process for storage in the set of at least one proxy buffer, in the event that the event message is to be forwarded.